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Geologic Challenges to a Young Earth

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GEOLOGIC CHALLENGES TO A YOUNG EARTH

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ABSTRACT

The science of geology presents severe challenges to the usually accepted young earth scenario held to by most creationists. Because of these challenges very few members of the geoscience professions are counted among the creationist ranks. We will look at the challenges, not with the purpose of denying the validity of creation but with the determination to face up to and solve the real difficulties geology presents to our viewpoint.

INTRODUCTION

In nearly any discussion of the age of the earth, reference is made to the work of Bishop Ussher. This is where we too will start. His calculations were based upon the genealogies presented in Genesis. Many creationists, including this one, have in the past held to an age of the earth which would fall in the same order of magnitude as Ussher's chronology. However, Usshers's chronology, as has been pointed out by many others, is wrong. This statement is not based upon evidence external to the Biblical record but upon the Scriptures themselves.

If we assume that the entire Biblical record is true, then Luke's insertion of Cainan into the lineage(1) must also be correct. Since no ages or dates are given in the case of Cainan, we are then numerically cut loose from the present. In calculating the date of the flood according to Ussher's methodology, we need to know how old Shelah was when Cainan was born and how old Cainan was when Arphaxad was born. Lacking either of these dates one can not calculate back to the time of the flood. One might wish to argue that Cainan is a later insertion into the Scripture but since the Septuagint, a 3rd century B. C. translation, also includes Cainan, one can easily argue that Cainan was accidentally dropped from our manuscripts.

With this release we are free to look at other evidence in order to determine the age of the earth. The geological problems confronting a young earth creationist can be divided into three separate areas - depositional problems, erosional, problems and structural problems. We will look first at the depositional problems, in particular the deposition of salt.

DEPOSITIONAL PROBLEMS

Whitcomb and Morris in the Genesis Flood(2) present an argument for the age of the earth based upon the rate at which salt is added to the oceans. Using the measured rates of addition of salt to the oceans, they calculate that only 50 million years would be required to account for all the ocean's chlorine. A similar calculation for sodium yields an age of 90 million years for the oceans.

Whitcomb and Morris then discuss two possible objections to this argument. First, the sodium and chlorine could be cyclical. This would require that the sodium carried into the oceans was somehow returned to the land only to be re-dissolved and returned to the oceans. Very little salt has been measured returning directly to the land via the evaporation of ocean water so it doesn't seem likely that this mechanism can account for the problem.

The second objection however, is more serious. It postulates that large amounts of the salt carried into the ocean basins is deposited on the floor of the sea and remains there. This salt would have to be included in any calculation of the sodium age of the ocean because

the quantity of salt in the oceans is only a part of the salt that has been carried into the ocean over time. Is there any evidence of this being the case? There is much salt that has been found contained within the sedimentary section. A well drilled in northern Utah penetrated 7,600 feet of salt.(3) A well drilled off Nova Scotia drilled through 4900 feet of salt known as the Osprey Evaporites.(4) 4,000,000 cubic kilometers of salt are found in the sediments below the Gulf of Mexico,(5) and salt is found in the sediments in the bottom of the Mediterranean over an area of 1 million square kilometers and averages 1 kilometer in thickness.(6) The Salina salt beds of the Northeastern United States can be traced for a distance of over 600 miles.(7)

Now in order for this objection to be effective in countering the dating of the oceans by salt it must be shown that the most likely place for the salt to have come from is the oceans. Whitcomb and Morris suggest that the great salt beds are due to metamorphism and tectonics and not to evaporation.(8) If their suggestion is true, then the salt found in the sediments came from some where else and doesn't need to be included in the calculations of the age of the oceans. If they are wrong, then the age they calculate must be too young.

The evidence which most persuasively argues for evaporitic salt is the fact that these salt deposits contain fossil pollen grains.(9,10) It is difficult to envision any metamorphic process in which pollen is included in the intruded material. Bacterial and plant spores have also been found.(11,12) These are not simply isolated occurrences either. The plant spores are found in quantities from 50 to 2,000 spores per cubic centimeter. Both of these facts seem to indicate that the salt was exposed to the surface of the earth where wind carried and deposited pollen, bacteria, and spores. No subterranean process can account for these facts.

Another fact which speaks against the metamorphic theory of salt's origin is that the salt is found sandwiched between other normal sedimentary rocks like sandstone and shale, and has bedding all of its own. If it were metamorphic, one would not expect the salt to be so conformable to the surrounding sediments. Thus we must conclude that since the salt can't be metamorphic, it must have been precipitated out of sea water. And if it was precipitated then the calculation by Whitcomb and Morris fails. This does not necessarily mean that the oceans are old, It means we can't date them by sodium and chlorine content.

How long would it take to evaporate something like the Mediterranean? According to Debenedetti, it would nearly all evaporate in a thousand years. This is really not all that long.

Several depositional and erosional features found in the geologic record imply a minimum age for the earth. The first of these is the varved or banded deposits found throughout the geologic record. The Salido, Castile,and Bell Canyon formations in west Texas contain 520,000 bands (believed to be 260,000 varves) over a total thickness of 1,467 feet.(13) The bands are so uniform in thickness over their entire area of deposition, cores taken in two widely separated oil wells (up to 15 miles apart) show identical patterns of banding. Geologists generally hold that these bands represent yearly varves implying a 260 thousand year time of deposition. If we creationists attempt to explain the deposition of this series of bands by a one year period of deposition, we are requiring one band to be deposited per minute - an impossible task over such a wide area. Assuming that these bands are tidally related we can account for the formation of four bands per day (two low tides and two high tides per day yielding two couplets) which would require over 350 years for this deposit to be laid down. It is difficult to see how it could have been deposited within a one year time frame.

Another layered deposit is the Green River formation found in parts of Wyoming, Utah, and Colorado. It is estimated to contain over 15,000,000 bands (7.5 million couplets).(14) The problem that this deposit presents for the traditional concept of flood geology is that the 2,500 feet of strata contained in this formation rests on top of about 25,000 feet of other strata which also must have been flood deposited according to the traditional view. Depositing 27,500 feet of sediment over a 365 day period gives a deposition rate of 75 feet per day. This then requires that 75 feet of laminations be deposited in one day. On average there are 6000 layers per foot of Green River formation meaning that the deposit, in order to be deposited within a one year period,required 5.2 layers to be laid down each and every second --layers that are fairly uniform in thickness spread out over 40,000 square miles. The mathematics just doesn't add up. One must then explain how fish droppings can be found throughout the formation as well as fossil fish, leaves, etc. At depositional rates as high as 75 feet per day, all traces of life should be buried in the first 75 feet of the deposit.

One must also explain how flamingos could build nests, leave hundreds of coprolites and how logs could become algal encrusted at those high rates of deposition. McGrew and Feduccia(15) relate that this find, located 104 feet below the oil shales, contained flamingo coprolites by the thousands, egg shells, flamingo, turtle,and crocodile bones, and algal encrusted logs.

If one studies the modern flamingo nesting sites in East Africa, one finds the same features, implying that the deposit found in the Green River Formation is best explained as a true nesting site. Logs can only become encrusted with algae and birds can only build nesting associations if the surface upon which they stand is free of deposition for at least a few months. The fact that bird foot prints are also found on the layers of the Green River formation argues strongly that the deposition was much slower than 75 feet per day since the birds must have time to take their stroll.(16)

In the case of the Green River formation, if we assume a tidal mechanism for band formation it would take over 10 thousand years to form this deposit. Unless some quicker mechanism can be found, the earth must be at least this old.

Chalk is a unique limestone since it is a very pure deposit of the carbonate shells of microscopic animals. The chalks of the Cretaceous age are found all over the world (17) and those penetrated by oil wells in southern Louisiana approach thicknesses of 1500 feet -- of little more than the dead bodies of living organisms. This is not a deposit that could have been dumped into place quickly. Modern estimates of the rates of sedimentation in the deep sea where chalk is deposited range from 1 to 3 cm. per 1000 years. Even if one postulates a coccolithic bloom in which 100 million coccoliths per liter of water occurred in an ocean 1 kilometer deep (3280 feet) that would leave a layer of coccoliths only 4 cm thick on the ocean floor. If this occurred every month, which it has never been observed to do, it would take about 1000 years to accumulate a layer of chalk 1500 feet thick.

Similar problems arise when considering the Miocene diatomaceous earth deposits found around the Pacific Ocean. In California these are known as the Monterey formation and are up to 3 kilometers thick.(18) Since these deposits are made up of little more than the remains of diatoms (microscopic plants) one has difficulties in fitting their deposition into a one year time frame not only because of the massive numbers of individual diatoms needed to account for these massive deposits but also because, like chalk, diatoms are extremely small and sink to the ocean floor very slowly. Using Stoke's law for a sphere of 20 microns in radius, the size of a diatom or coccolith, falling through a viscous liquid, we find that it would take anywhere from 8 to 50 years for the small particle to sink to the ocean floor. Any turbulence would tend to keep the particles in suspension. Because of this it is difficult to envision chalk and diatomaceous earth being deposited as the result of a turbulent flood.

Using a similar diatom bloom as we used for chalk, we find that it would take nearly 7 thousand years to deposit the observed thicknesses of diatomaceous earth. Somehow these deposits must be incorporated into creationist theory.

An equally difficult deposit to account for is the Lower Mississippian crinoid beds which are distributed nearly over the entire earth. In Alaska these beds are called the Lisburne limestone; in Canada, the Rundle; in Montana and Wyoming, the Madison; the Leadville in Colorado; the Redwall in Arizona and New Mexico; and the Chappel in Texas. These beds, which are made of little more that the shells of crinoids, continue northeast from Texas and are called the Burlington and Keokuk in the mid-continent. These beds are also found spread across Europe, Asia,and Africa. Why are these beds so difficult to explain? This author once calculated that the dead crinoids in just the Madison formation alone, are enough to cover the earth to a depth of 8 centimeters. (19) If, as traditional creationist thought would have it, these trillions of dead crinoids were the victims of the flood one must wonder where they all lived let alone all the other species in the animal and plant kingdoms. The large mass of dead crinoids must require more time than a one year flood allows. There would not be enough room on the earth's surface for them to have lived simultaneously before the flood.

EROSIONAL PROBLEMS

When we turn our attention to erosion, we are once again confronted with problems. Observed rates of erosion would lower the continents to sea-level in some 14 to 35 million years. Many creationists have discussed this fact, and it is a very strong argument for a young earth. Old earthers try to escape the conclusion implied by this argument by appealing to uplift of the continents due to continental collision. They would say that due to the fact that the continents are drifting apart and colliding together, the landscape is constantly being rejuvenated and uplifted by repeated collision. The Appalachian Mountains are believed to have been created by the collision of Africa and North America during the Permian. Since that time they have been eroding and thus they are not as grand and majestic as the younger Rocky Mountains.

The average rate of erosion over the entire continent has been estimated to be around 1 inch per one thousand years. Assuming this very slow erosion rate has been constant all the way back to the Permian when the Appalachians were formed, requires that the mean elevation of the Appalachians at that time be over 25,000 feet. One might not think that that is too

great until it is realized that the mighty Himalayas have a mean elevation of only 17,000 feet. This also does not take into account the fact that as the elevation increases the erosion rate becomes larger. For instance, the high plateaus of Zion National Park are being lowered at a rate of 1.5 to 3 feet per thousand years(20) while the Transverse Mountains in California have an erosion rate of 7.5 feet per thousand years.(21) If one were to include the increase in erosion in the case of the Appalachians, one would find that when formed, if it was indeed 225 million years ago, they extended beyond the earth's atmosphere--an absurd result. Thus the person holding to the conventional view of geologic time must deal with the problem presented by the rates of erosion.

However, the young earth creationists, like the old earthers, have generally ignored the problem presented by these same erosion rates when regional unconformities are discussed. The southern part of the Appalachian mountains are buried beneath the Cretaceous coastal plains sediments. Seismic data acquired by Texaco (22) shows the Paleozoic Appalachian strata contorted into folds 10-20,000 feet high with up to 10,000 feet eroded off the top of the folds. These flattened folds are then covered by 2,500 feet of unfolded Cretaceous strata. In order for this sequence to be explained, the lower,older Paleozoic strata had to have been deposited flat, then lithified because soft sediments do not produce thrusts, then folded and thrusted, then 10,000 feet eroded, then finally 2,500 feet of Cretaceous rocks deposited on top of this. This sequence requires four spans of time: 1)the deposition of the Paleozoic section; 2)the folding of the Paleozoics; 3)the erosion of them; 4)and finally the deposition of the younger rocks. Similar sequences are found elsewhere in the world, in the North Sea, Southern Oklahoma, and at the base of the Grand Canyon. How much time did it take to erode the mountains? The fact that they had to have been lithified requires that the rates be relatively slow. Using the fastest rate of erosion listed above, it would take 1,300,000 years to erode ten thousand feet off of the buried Appalachians. This would have to be done before the 2500 feet of strata were deposited on top of them.

Many features noticed within and on the various strata prove that the deposition rates were relatively slow. A study of the Upper Glen Rose section near Bandera,Texas reveals many of these traits. (23) Each layer in the Pipe Creek section displays burrows and fossils found in their life position. Presumably it took some span of time for the burrowing to occur. Many surfaces of these beds show the development of caliche, mudcracks and ripple marks. Many of the mudcracks are filled with material associated with the next higher strata. Even if we are able to speed up these processes from the several thousand year time frame assumed by geology, the fact remains that these processes can not occur instantaneously. Some time lapse is required between the deposition of the layer upon which these features reside and the deposition of the next layer. Close examination of many of the fossils shows that the burrower cut through not only the rock material but also through the fossils which proves that the fossil was deposited before the boring took place. It is difficult to conceive of a small marine animal burrowing into the surface of a rock layer while nearly 100 feet of sediment are being dumped on top of him every 24 hours. Further, many of these burrows are morphologically identical to burrows found today which are made by animals which will only dig into hard rock. This implies that the rock had become hardened prior to the boring and prior to the deposition of the next layer.(24)

Erosional channels are quite common in the geologic record. Channels up to 70 feet deep and 1000 feet wide are found eroded into the Supai group in the Grand Canyon and then filled in with material identical to the next higher layer. (25) In Oklahoma, similar channels have been mapped in Pennsylvanian sediments by means of oil wells and some of the channels are quite prolific oil reservoirs as in the case of the Booch sandstone. The distribution of the Booch sands observed in the subsurface is remarkably similar to that of a modern delta. (26) Miocene sands mapped by this author in Southern Louisiana display a definite dendritic pattern much like a modern drainage system.

Using the hydrodynamics of modern river flow one can derive equations which bracket the amount of sediment a river can carry each year. These calculations are based upon the size of the channel, and meander size. They show that Morrow channels found in northwestern Oklahoma would require 316,000 to 527,000 years to deposit the 1,500 cubic miles of sediments found in the Upper Morrow section.(27) Many will question whether or not the Morrow channels did indeed carry the sediments ascribed to it. One can only answer that rock fragments whose parent bodies can only be found in Colorado are found all along the Morrow channels and are found abundantly within the 1,500 cubic miles of Morrow sediments. Since the channels can be followed by wells from Colorado down to west central Oklahoma, it is reasonable to assume that the channels did carry the sediments.

One final erosional problem. From south of Ardmore, Oklahoma, to Amarillo, Texas, stretches a subsurface geologic feature known as the Wichita Mountains. This buried granite mountain range is covered in places by Cambrian to Ordovician sediments. The Cambrian sediments are known as the Arbuckle group, which is a dolomite. The lowest Ordovicion sediments cover the Arbuckle group and consist of sandstone and shale and are called the Simpson group. The

Upper Ordovician sediments are the Viola limestone which covers the Simpson. When oil wells drill down to granite on top of the Wichita mountains they most commonly find that the three formations have been eroded completely away. We know that the three formations once covered the granite because there are isolated areas where all three formations are found. Where is the eroded material?

When one drills oil wells just north of this buried feature, he first encounters what is called a granite wash, made of particles of granite identical to the granite of the Wichita mountains. As you drill deeper, you then find a carbonate wash whose particles are identical to the Arbuckle group.(28,29) Next one finds sand and shale particles similar to the Simpson and finally a carbonate wash made up of particles of Viola limestone. Since the deepest deposit was the earliest eroded material, we have a situation in which enough time transpired between the deposition of the Viola limestone and the deposition of the sediments currently covering the Wichita Mountains, for the erosion of nearly all of the Viola, followed by the Simpson and Arbuckle and finally the erosion of the granite itself. Time is necessary.

STRUCTURAL PROBLEMS

Structural indicators of age are seen every where in the geologic record. The buried part of the southern Appalachians mentioned above are a perfect example. The Lower Paleozoic rocks were folded, faulted, and thrust over each other before the Cretaceous strata was deposited on top of them. How do we know? The faults do not cut the Cretaceous strata, nor are the Cretaceous strata folded or thrusted. Thus, the episode of folding and faulting occurred before the Cretaceous strata was deposited. A similar situation can be seen in the North Sea where the Devonian to Jurassic strata have been faulted and tilted but the Cretaceous to Tertiary strata which overlies them, are unfaulted and lie relatively horizontal. (30) One salt pillow in the North Sea shows two different periods of structural age. The Zechstein to Jurassic strata were deposited horizontally before being uplifted and faulted. Next the Cretaceous and Lower Tertiary deposits were laid down. In the Late Tertiary the Zechstein to Jurassic strata as well as the Cretaceous to Early Tertiary deposits were uplifted and faulted again. They were then buried by horizontal Late Tertiary sediments. To form this structure requires three separate periods of time. (31)

CONCLUSIONS

Do these challenges to a young earth imply that there was no world-wide flood? Those who are used to viewing the entire geologic record as being the result of the flood, deposited within one year, might be tempted to think so or to think that this paper is attacking the idea of flood geology. The difficulty can be resolved by changing our view of how the flood accomplished the geologic work. If, instead of the traditional view, we place most of the geologic work after Noah left the ark, and give ourselves a little more time than we have given ourselves in the past, then we can have a better chance of explaining the geologic problems.

As outlined in a previous article (32), Noah and the animals left the ark while Cambrian strata were being laid down. They would have had to live on a stable highland for several centuries while the geologic effects of the flood continued below them. As the animals repopulated the earth and spread out from their initial center, they were vulnerable to all the vicissitudes of their turbulent world. They would inhabit areas that for the moment were secure only to have some later regional catastrophe bury them thus making them fossils. The more rapidly the animals reproduced, the more rapidly they would spread out and thus the more probable that they would be caught in one of these disasters. This would lead to the expectation that we should find the different groups in the fossil record based not upon hydrodynamic sorting and mobility but based upon their reproduction rates. In point of fact this is precisely the order in which fossils appear in the geologic column.

Thus, as many centuries passed and the earth gradually calmed down, animals were able to maintain a somewhat normal life style including the building of nests, like the flamingoes, the burrowing of the sediments, which also included burrowing through the shells of their predecessors, and the leaving of their footprints in the normal course of their behavior. Some areas would be eroded like the southern Appalachian and Wichita Mountains while other areas were eroded leaving channels which would be buried later. There would be time for different periods of structural development. Mudcracks would occur as we see them occur today. Salt could be precipitated onto the ocean floor. Only when the catastrophe occurred would some of these features be captured in the fossil record.

How old is the earth? Using the best geological argument, the rate of erosion of the continents, we must answer that it is younger than 14 million years. The minimum age must be the time necessary for the deposition of the Green River formation plus the section underlying it, at least a hundred thousand years. If this disturbs the reader, we must not forget that any age of the earth less than a hundred million years precludes evolution and

requires a creator. It is evolution not the age of the earth which is harmful to the Scriptures. The age should only become an issue when the age itself seems to require evolution.

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DISCUSSION

Mr. Morton has done an excellent job of citing several of the areas of data which show us that it would have been impossible for the major parts of the earth's sedimentary cover to have been formed by the Flood, without special miracles. Data such as those contained in his paper regarding the nature of evaporite deposits far inland on the continents, and the extent and nature of the world's chalk, diatom, and crinoid deposits have been collected and repeatedly verified by many teams of petroleum geologists during the past 25 years.

The examples of folding and faulting of well-lithified sedimentary rock before non-faulted, non-folded strata were added (pp. 4 and 5) to provide further incontrovertible evidence for sedimentary deposition over long periods of time. So, I feel that Mr. Morton has cited high-quality data in support of his thesis.

I see some serious problems, however, in Mr. Morton's attempt to account for practically all of the sedimentary cover of the earth in as little as 100,000 years following the Flood (p. 5). Like him, I reject macroevolution and abiogenesis, but there is an immense amount of carefully-collected, non-radiometric data which indicate that much more than 100,000 years were required for the forming of the sedimentary cover. One of these areas of data is that concerning the time required for the lithification of rock strata. The primary means of lithification of practically all limestones and sandstones, and of many types of siltstone and related rocks, is cementation. This is the building in of very small "cement" crystals between the sediment grains in order to bind them together. These mineral crystals are derived from the appropriate ions borne by water which percolates through the sediment mass. For example, 80,000 to 90,000 years are required for cementing a body of carbonate sediment 10 meters thick into hard limestone, if a constant flow of ion-bearing water is maintained throughout the sediment mass during the entire time. This calculation, made by R. G. Bathurst and his colleagues, is based on observed cementation rates in the Bahamas, and on our knowledge of the amount of Ca^{++}, Mg^{++}, and CO_3^{--} ions which can be carried in solution in relatively warm sea water.

Another major fault in Mr. Morton's post-Flood, 100,000-year model is that it does not provide anything like sufficient time for the deposition of the (largely biogenic) Great Bahama Bank or for the many other large, in situ biogenic structures which are deeply buried in any of the oil fields of the world.

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This paper presents information which needs to be seriously considered by scientific creationists, those who generally approve of the Whitcomb and Morris perspective on biblical interpretation and the approach to historical geology which results. Most of the arguments presented in the paper call for more time since the origin of life. But the author settles in general with a qualitative call for more time. In some instances he is quantitative, and we see that the geological record does not normally economize in time, and that many fossils are enclosed in their fossilized living habitats, which took altogether much more than 100,000 years to form and consolidate.

With respect to the topic of erosion and how the rates of erosion limit the age of mountain ranges, the author presents two approaches to the calculations: Let me dwell for a moment on this topic since it becomes the author's choice argument for part of his conclusion.

One approach takes the average rate of erosion to be constant with time and the height of the mountains, and understandably arrives at an initial height for the Appalachians by multiplying the geologic age attributed to the chain, by the rate of erosion. That would be the total height lost by the mountain range (loosely speaking) during that time span, assuming it was formed rapidly without erosion at work.

When the author mentions another approach to the calculations where the rate of erosion is taken to be related to the average altitude of the mountain chain, I believe he falls into error. It is true that if we take an empirical rate of erosion proportional to altitude, a differential equation leads to absurd initial heights for a 225 million year mountain chain. But the whole reasoning is not realistic. A mountain chain does not start out at maximum height. It "grows" in the presence of erosion, and as it "grows" higher, the erosion becomes exponentially greater, as seen by examples presented by Mr. Morton. Thus, in the presence of erosion proportional to altitude, a mountain would never get unreasonably high even if very, very old. The balance is between growth, altitude and erosion rate, not

merely between maximum altitude and erosion rate, as Mr. Morton and others have suggested.

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The first sentence of the abstract of Glenn Morton's paper could be changed to read, "The recent uniformitarian literature of geology presents severe challenges to the view of creationists published 25 years ago." Glenn ignored important catastrophist publications in the same largely uniformitarian journals he reads. He considers only the Whitcomb and Morris models (written more than 25 years ago!) and ignores the more recent creationist works on geology. Does the science of geology challenge a young earth? Glenn Morton's paper leaves the question largely unresolved.

Specific literature not cited by Glenn Morton:

A. A. Roth, 1985, "Are Millions of Years Required to Produce Biogenic Sediments in the Deep Ocean": Origins, Vol. 12, No. 1, pp. 48-56. (Directly relevant to the origin of chalk; a significant creationist author.)

D. I. Nutting, 1984, "Origin of Bedded Salt Deposits: A Critique of Evaporative Models and Defense of a Hydrothermal Model": Unpublished M.S. thesis, Institute for Creation Research, 107 p. (Critique of conventional model which Morton accepts; evaluation of evidence favoring catastrophist model; represent two years of work by a creationist.)

D. J. W. Piper, 1972, "Turbidite Origin of Some Laminated Mudstones": Geology Magazine, Vol. 109, pp. 115-126. (One of numerous articles in conventional literature challenging long time periods to form laminated deposits.)

S. A. Austin, 1984, "Catastrophes in Earth History": Institute for Creation Research, Technical Monograph No. 13, 318 p. (Abstracts of scientific and technical articles, many of which directly relate to topics of Mr. Morton's paper. Mr. Morton could have included some of these references from catastrophist and "neocastastrophist" literature.)

Steven A. Austin, Ph.D.
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Mr. Morton employs several arguments which are both indefensible and disturbing.

(1) After showing a well-known problem in biblical chronology (i.e., Cainan), he claims a "release" from a meaningful understanding of these chronologies. However, to place 100,000 years into the biblical framework is to reduce Scripture to meaninglessness.

(2) Mr. Morton then claims subjective geology can interpret scriptural history for us.

(3) Evaporitic salt does contain abundant pollen grains. However, the laterally extensive and thick salt beds found buried in the stratigraphic record do not, nor do they contain meteoric dust or wind-blown dust. Morton's argument based on evaporitic salt seems to be a straw man.

(4) Morton's arguments in general critique the older creationist material; many of his charges are now invalid.

John D. Morris, Ph.D.
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CLOSURE

I would like to thank all of the reviewers for their criticism and suggestions.

I would agree that the deposition of limestone presents a problem to a creationist who wishes to explain the earth in a short time frame. Under current natural law, the figures cited by Mr. Wonderly could be a problem for a young earth. However, it has always been this author's contention that the only way out of many of these difficulties is to examine

possibilities in which the natural law was different in the past. Only after that avenue is fully considered and investigated can we truly say that we have examined all possibilities.

Secondly, Mr. Wonderly apparently overlooked the final paragraph in the article in which I only hold to an earth younger than 14 million years old.

Everyone would agree with Dr. DeVilbiss that mountains do not pop up out of the earth fully grown but that they grow with erosion occurring as they rise. However, most authorities would also agree that the Appalachians have not experienced significant uplift since the terminal Paleozoic orogeny which according to actualist views occurred between 250 and 200 million years ago, and it is called the Appalachian orogeny in this country. It was during this 50 million year period that actualists think the Appalachians arose. Since that time there has been no significant orogenic activity in the Appalachians and the subsequent history of the mountain chain has been one of erosion. The lack of orogenic activity in this region since the Late Triasic is evidenced by the gentle onlap of undisturbed Jurassic, Cretaceous and Tertiary strata all along the eastern and southern edge of the Appalachin-Ouachita trend.

Thus Dr. DeVilbiss' argument fails since the Appalachians have been experiencing little but erosion for 200 million years (in his view), and applying an increase in the erosion rate as the mountains were taller in the past is a perfectly valid approach to the problem and leads to absurd results. Thus the Appalachians could not be 200 million years old.

It is difficult to reply to a bibliography. I do not claim to either have read everything nor can I cite everything I have read. Dr. Austin does not raise any substantive issues but merely points out some of the literature that I didn't cite. Some of this material I have read, some I have not. But if his purpose is to point out that I have been unable to read everything, I plead guilty.

Dr. Morris criticizes the paper for putting a minimum of 100,000 years into the biblical framework and says that reduces the Scripture to meaninglessness. However, he himself suggests a 10,000 year age for the earth which also does not agree with Usherian chronology. It would seem to me that we both are doing the same thing, namely inserting more time into the biblical chronology. The question is not what we are doing; that is clear. The question is how much extra time is allowed.

I fail to see how geology is subjective. One can go and count the bands in the Green River formation and should arrive at the same number regardless of whether one is a creationist or geologist or geophysicist or anything else. That seems to be an objective fact. So how are we to account for the large number of bands in one year?

To say that salt does not contain pollen is to ignore the vast palynological literature on salt, some of which I cited in the paper. Dr. Morris needs to read a few of them.

Dr. Morris gives no substantive example of my charges being invalid. It is difficult to respond to this final critique since no examples are given.

Glenn R. Morton